**WATER RESOURCES RESEARCH GRANT PROPOSAL**

**Project ID:** 2004CT31B

**Title:** Chaotic Advection Enhanced Remediation

**Project Type:** Research

**Focus Categories:** Groundwater, Treatment, Solute Transport

**Keywords:** Natural Attenuation, remediation, chaos theory

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**Congressional District:** 2

**Principal Investigator:**
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## Abstract

Despite large financial investments, groundwater remediation is falling short of general expectations. Most of the current technologies are capable of containing problems but are unable to restore the water to meet health standards in a reasonable time frame. Conventional methods such as pump and treat are slow and expensive and, therefore, the field of groundwater remediation needs cost effective and time efficient technologies. Recent developments in the field of chaotic advection in low Reynolds number flows have led to the belief that a system of oscillating wells (vis-à-vis injection or withdrawal with time-dependent flow rates) could cause substantial mixing in an aquifer. This could have profound remedial effects when combined with the advection and dispersion, sorption, and biodegradation aspects of natural attenuation. Contaminants would dilute, sorb or desorb depending on the contaminant-soil affinity, and be exposed to a greater number of enhanced microorganisms.

It is hypothesized that the accelerated mixing provided by chaotic advection will enhance the remedial aspects of natural attenuation. This in situ technique treats pollution at its source converting contaminants into carbon dioxide, water, and new cellular mass. Chaotic Advection Enhanced REMediation (CAEREM) could possibly turn decades into years, while reducing both exposure risk and clean up costs. In this research work, we

propose to use flow and transport modeling to study the mixing phenomena created in groundwater by oscillating wells. To quantify mixing, an index will be developed using the concept of average inter-particle distances and compared with the dilution index, presented in the literature before. Real world practical design considerations will be examined and laboratory-scale experimentation will provide for model testing and verification.